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SYNOPSIS—Mineral resources of Brazil are varied and extensive, but mining industry has not flourished. It is principally represented by two gold mines, five manganese mines and monazite-sand shipments. Minor outputs of diamonds, semi-precious gem stones, copper and coal. Mining development insignificant, though Brazil exceeds in area the United States.

In many respects Brazil is the least known of any of the major countries of South America, and accurate information regarding it is difficult to obtain. Even the residents of the country seem to be hopelessly ignorant of all sections other than their own immediate one. Before leaving the United States we were unable to secure much exact information, but trusted that this dearth would be readily supplied on reaching Rio de Janeiro, only to find that there it required much time and effort to get even general facts. One must search long in Rio de Janeiro to find a person who can tell him anything definite about the distant states of the country or even the near-by states. In Brazil one soon learns to appreciate the importance of railroads and newspapers in the dissemination of news, and while Brazil was very active in railroad building before the outbreak of the European War, yet the gaps in the railroad system are so great that one region knows little of what another one is doing.

When one reads the scattered literature or examines the mineral specimens in the various Brazilian museums, one is apt to get the idea that all sections of Brazil are rich in their economic mineral resources. Gold is said to occur in every one of the 21 states, while most of them report the presence of numerous other products such as iron, copper, manganese, lead, zinc, antimony, platinum, silver, mercury, monazite; precious stones, including the diamonds, topaz, quartz, amethyst, agate, tourmaline, sapphire, ruby, beryl, emerald and aquamarine; coal, sulphur, graphite, mica, talc, great varieties of clays and

OURO PRETO, FORMER CAPITAL AND MINING CENTER IN MINAS GERAES, THE LEADING MINING STATE OF BRAZIL

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building stones. In most cases the only information to be obtained is that specimens of the particular minerals have been brought from these regions, and no one knows the character of the deposits. With few exceptions the localities yielding the specimens are so remote from transportation lines as to preclude the possibility of their development at present.

Except in a few states the mineral resources of Brazil are entirely undeveloped and their possibilities unknown. While unquestionably the greatest wealth of the country in the future will be derived from agriculture because of every section being suitable for cultivation, grazing or forestry, there is little doubt that the mining industry also is in its infancy. The country needs an increased immigration, which will probably now be slow in coming on account of the European decimation; and until the population and wealth of Brazil materially increase, the greater portion of the agricultural and mineral resources

OUTLINE MAP OF BRAZILIAN STATES

must remain undeveloped, the reserves for future generations.

The mining industry of Brazil has stagnated, while the agricultural and manufacturing industries have rapidly increased in wealth and importance. Many causes have contributed to this state of affairs. The mining laws have for years been in an unsatisfactory condition, and lawyers say that they are in a hopeless jumble. Some states have passed special laws pertaining to mines, but more systematic revision is needed. The Federal law gives all minerals to the owners of the land, and the landholders have been in all too many cases inclined to demand exorbitant prices for the minerals present, and unable or disinclined to operate them themselves. Even when one wishes to buy land, it is a difficult matter to obtain title, as many immense estates have passed undivided through the hands of several generations. Brazilian families are large—10 to 15 children not at all uncommon, and in many cases more than 20 in one family—so one can see the large numbers of owners of an estate undivided for even three generations. In one case we were told of the sale of a mineral property where examination showed it to be held in common by over 700 persons whose titles were good. Under the present conditions the prospector has not had so good an opportunity as in the United States or Canada, and the type of man responsible for the initial stages of mining in North America is practically nonexistent in Brazil. Where surficial decomposition of the rocks is deep and vegetation is dense, prospecting is both difficult and expensive. Systematic prospecting must ever be more profitable in Brazil than desultory one-man exploring parties, and for such work capital, thus far lacking, is absolutely necessary.

In comparison with the past the decadence of mining is probably due mainly to the change in the labor situation. When slavery existed, low-grade gold and diamond mines that are now idle could be worked with profit. As the soil is very fertile, a slave who was allotted a small plot of land would with one or two days' labor each week produce enough for the support of himself and family, and during the remainder of the time he would wash gold and diamonds for his owner. All this was changed with the abolition of slavery, and the shortage of the labor supply and the exhaustion of the precious minerals that could be obtained by small outlay of capital have caused a great decrease in the mining industry.

Most Important Mines Held by Foreigners

The most important mines now in operation are owned by foreign capital, and as few rich Brazilians care to engage in mining, more money from the countries of Europe or North America must be forthcoming before mining in Brazil attains the importance that the varied character of its mineral resources would seem to warrant.

At present practically all the mining in Brazil is confined to four states: The state of Bahia produces some manganese, monazite, gold and diamonds; Goyaz has some working gold and diamond mines; Espirito Santo produces most of the monazite exported from the country; while the state of Minas Geraes, which has from the beginning been the principal mining region, has extensive gold, manganese and diamond workings and contains enormous iron-ore deposits unequaled in any other part of the world. By many persons Goyaz is regarded as the most promising mining state, but its lack of railroads and the almost complete absence of any development work prevent one from forming any definite conclusions regarding its possibilities, and the interest of the mining industry continues to be centered in Minas Geraes. During an extended trip through most of the important mining districts of South and Central America during the past year, we were given an opportunity to visit the various mines of Minas Geraes and to collect information such as they had been unable to obtain before.

The state of Minas Geraes lies due north of Rio de Janeiro and, next to São Paulo, is the richest state in the republic. Although it does not border on the ocean, it was nevertheless one of the first states to be settled, because of the valuable minerals that were early found there. At present it contributes the greater supply of the minerals mined, yet it does not owe its wealth entirely to its mineral resources. Much coffee is grown on the cleared ground, even where the hills are very steep, and the cattle and dairy industries are well developed.

Minas Geraes, although within the tropics, has a pleasant climate, as most of the state lies a few thousand feet above sea level. Many residents of Rio de Janeiro spend

the summer months of January, February and March in Bello Horizonte or other cities of Minas. The country is extremely hilly, and the hills seem scattered everywhere without any order or system. Crooked streams wind their way between the hills, which are in the main steep, especially near the streams.

The country was probably at one time covered with dense forests, but large areas have been cleared, although some regions where the trees have been removed are now covered with thickets of brush so dense that one can scarcely push his way through. Along the streams the forests with the tangles of bamboo and climbing plants form such a barrier that the tapirs and monkeys are the only animals of any size that can pass through them. We experienced considerable difficulty in getting our mules through the thickets where there were no beaten trails constantly in use. So rapidly does the vegetation grow that the paths can be kept open only by the frequent use of the machete.

The mining state of Minas Geraes owes its name to the varied mineral products that were early found there by the Paulist Fathers, who pushed their way inland from the coast settlements. The name means "general mines" or "all kinds of mines."

It is said that the first specimens of gold that the priests obtained from the region were brought to them as early as 1540, but they did not visit the region and find the precious metal themselves until 1694. The Portuguese in Brazil were as eager for gold as were the Spanish on the West Coast, and the search for the yellow metal was extended far and wide and their efforts were rewarded with great success.

In 1721 the first diamonds were discovered in Minas Geraes, near the present town of Diamantina. The story of the discovery is that a priest who had previously seen rough diamonds in India recognized the stones in the stream pebbles that were being worked for gold. Without exciting suspicion he obtained possession of a great many, some of which had been collected by the gold miners on account of their brilliancy, and then journeyed quickly to Rio de Janeiro, whence he sailed for Portugal with his treasures. Just as he was about to sail, he announced that diamonds were being found in the gold field of Minas Geraes. Naturally there was a "rush" to the regions, and the Portuguese government quickly seized all the mines and had them worked for the Crown. While the government profited immensely from the diamond mines for many years, the supply was not exhausted, and the district continues to yield a considerable quantity annually. Statistics of production are of little value, as many are found and never reported, because of the tax which the government imposes upon the stones found.

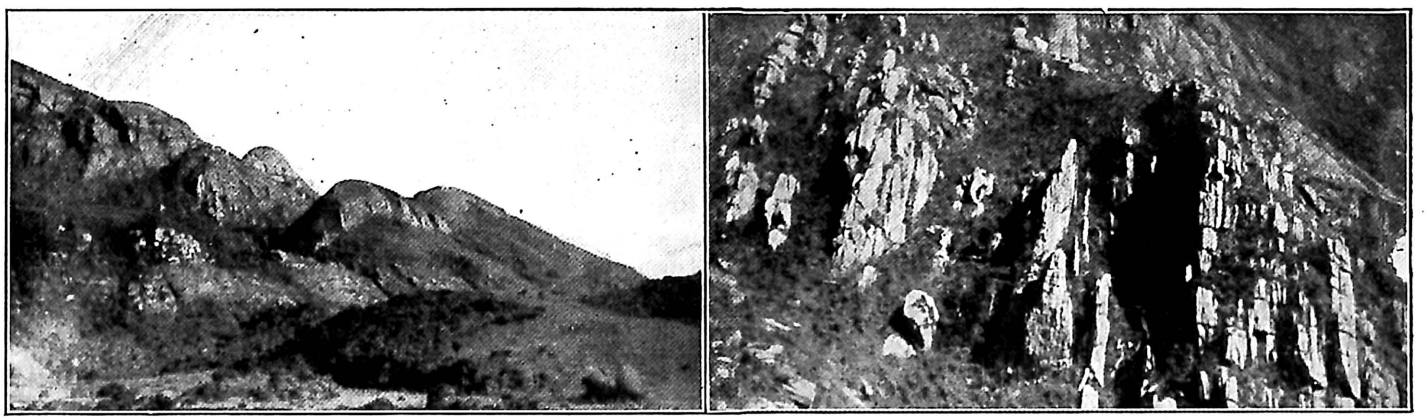
The iron ores were perhaps the next mineral deposits to attract attention, and small forges were erected in several places throughout the region to supply the gold and diamond workers with the small amount of iron required. But the total amount of iron made from the Brazilian iron ore is inconsiderable, and these extensive deposits remain practically untouched.

The manganese ores of Brazil were developed much later, as they are all exported and no use could be made of these materials until the Central Railroad of Brazil had been extended near the deposits. However, at present the value of the output of manganese ore ranks next to that of gold.

Poorly Managed Government Railroads

The railroads of Brazil have been of the greatest importance to Minas Geraes and yet in their equipment and management leave much to be desired. The one described is a government-owned line, and many of its defects are not seen in the railroads owned and operated by private capital. Leaving Rio de Janeiro at 7 p.m. by the Estrado do Ferro do Brazil, the next morning the mining region of Minas Geraes is reached. To one not acquainted with Brazilian railroads or especially with the government railroads of Brazil, the night ride from Rio is one long to be remembered. The sleeping cars are light and the roadbed so rough and the line, which follows crooked streams, has so many curves that one is continually thrown from side to side of his berth. To lie on one side it is necessary to have arms extended as sort of buttresses. The cars, which are old, have been so shaken apart that in going through tunnels the smoke enters through numerous cracks in such volume as to almost suffocate one, while during the dry season the dust comes into the cars in clouds.

Since the European War caused the price of coal to advance to such a point that its use had to be curtailed, many of the railroads have been using wood in their locomotives. On a dark night the sparks flying from the engine's smoke-stack suggest Fourth of July pinwheels, and it is a common occurrence to have the wooden cars catch fire, while the person who rides far on these trains without having holes burned in his clothes may consider himself lucky.



TYPICAL VIEWS OF MINAS GERAES MINING DISTRICTS—OUTCROPPING LEDGES OF HIGH-GRADE IRON ORE

The standard-gage line extends to Miguel Burnier, 287 mi. from Rio, beyond which the track is narrow gage. The railroad has been built to Pirapora on the São Francisco River, a distance of about 600 mi. Branch lines run to Diamantina, Bello Horizonte, Marianna, Santa Barbara and other points.

While new railroads are projected and will undoubtedly be built as soon as financial conditions are improved, it will be some time before the mining industry will be changed materially. The diamond operations can continue practically as well without railroads as with them, for it has been demonstrated that elaborate equipment is not adapted to the recovery of the precious gems in Brazil. An English company that invested $1,200,000 in a property near Diamantina, which was equipped with steam shovels, etc., failed to make expenses, although the natives working with the shovel and batea are able to make a living. The railroad reached the diamond region less than two years ago, and the industry has shown no improvement.

In the gold region increased railroad facilities will not at once stimulate the mining industry, as the two big gold mines of Brazil are now reached by railroads and the dredging operations are still of questionable value, while the desultory gold washings along the smaller streams could not be aided by better means of transportation.

In spite of poor railroads and high freight rates, the manganese mines of Minas Geraes have done well. The occurrence of other manganese-ore deposits is known, and their geologic character leads one to believe that they may prove to be of equal value to those already in operation. No doubt, as new railroad lines are constructed the manganese industry will be improved.

No Brazilian Coke Available for Smelting Iron Ores

The iron industry is in greatest need of new and better railroads. While the country has hundreds of millions of tons of high-grade iron ore, nevertheless about 500,000 tons of iron is said to be imported annually. The absence of coking coal is the principal handicap in the development of local iron manufacture, and it is generally recognized that Brazil's iron ores must be marketed in foreign countries. The Central R.R. passes through the iron region and branches could be built from it to the most important deposits, but the present line is poorly suited for iron-ore shipment and entirely incapable of handling large amounts. A railroad that is being built from the port of Victoria is not much better, and before the deposits can be extensively worked there must be a line especially constructed for iron-ore shipment, which will involve a large expenditure.

As one goes through the iron region and observes the enormous deposits of almost pure hematite ore, one cannot fail to regret their present inaccessibility. While these deposits have long been known, it was not until Dr. Orville A. Derby called attention to them in 1910, in the report on the "Iron-Ore Resources of the World," prepared for the International Geological Congress held in Stockholm, that foreign interests were attracted to them. American, English and German companies shortly entered the field, and the possession of these valuable deposits has now largely passed into the hands of foreigners, who are at present "sitting tight" and waiting.

In spite of the descriptions that have been published of the Minas Geraes iron-ore deposits, it is doubtful whether anyone who has not seen them can adequately appreciate their extent. A noted iron man of the United States has said that had one of his assistants returned from Minas Geraes with an accurate description of what occurs there, he would have sent him back with the admonition to tell the truth on his next return. In fact, a man who truthfully describes the Brazilian iron-ore deposits is apt to lose any reputation for veracity that he might previously have had. When one sees whole hills of iron ore that would average 65% to 68% Fe, square miles of territory covered with brecciated ore (*canga*) to the extent of 5 to 50 ft., the whole averaging between 50% and 60% Fe, and in places, masses containing 25,000,000 to 50,000,000 tons of 68% Fe ore, he cannot fail to be surprised. It seems that within a radius of 30 to 40 mi. there are a few billion tons of 60% Fe ore and no one knows how much 50% Fe material.

In a few places in the district the loose specular-hematite ores are being worked and iron is made in small forges. The loose ore, consisting of extremely fine bright flakes, is put into a small furnace mixed with charcoal. At intervals more ore and charcoal are added until finally a ball of iron and slag is formed. This is then pounded by a trip hammer run by a waterwheel until the slag is largely removed. There are said to be a number of forges of this kind throughout the iron regions, but thus far the attempts to smelt the iron ores in blast furnaces have not met with much success, even though the Brazilian government has probably offered greater inducements than any other government has ever done to encourage this industry.

The total value of the annual mineral production of Brazil is about $5,000,000. Roughly one-half of this represents the gold output, one-third the manganese, one-tenth the monazite, and the remainder, about $300,000, is divided among the outputs of diamonds, copper and coal plus small amounts of numerous minor products. For a country that exceeds in size the entire United States, excluding Alaska, such figures indicate either the lack of many valuable mineral deposits or else their nondevelopment. The latter cause is thought to be the principal reason for this state of affairs.